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Polarization angle swings in blazars: The case of 3C 279

Kiehlmann S., Savolainen T., Jorstad S., Sokolovsky K., Schinzel F., Marscher A., Larionov V., Agudo I., Akitaya H., Benítez E., Berdyugin A., Blinov D., Bochkarev N., Borman G., Burenkov A., Casadio C., Doroshenko V., Efimova N., Fukazawa Y., Gómez J., Grishina T., Hagen-Thorn V., Heidt J., Hiriart D., Itoh R., Joshi M., Kawabata K., Kimeridze G., Kopatskaya E., Korobtsev I., Krajci T., Kurtanidze O., Kurtanidze S., Larionova E., Larionova L., Lindfors E., López J., McHardy I., Molina S., Moritani Y., Morozova D., Nazarov S., Nikolashvili M., Nilsson K., Pulatova N., Reinthal R., Sadun A., Sasada M., Savchenko S., Sergeev S., Sigua L., Smith P., Sorcia M., Spiridonova O., Takaki K., Takalo L., Taylor B., Troitsky I., Uemura M., Ugolkova L., Ui T., Yoshida M., Zensus J., Zhdanova V.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© ESO, 2016.Context. Over the past few years, on several occasions, large, continuous rotations of the electric vector position angle (EVPA) of linearly polarized optical emission from blazars have been reported. These events are often coincident with high energy γ-ray flares and they have attracted considerable attention, since they could allow us to probe the magnetic field structure in the γ-ray emitting region of the jet. The flat-spectrum radio quasar 3C 279 is one of the most prominent examples showing this behaviour. Aims. Our goal is to study the observed EVPA rotations and to distinguish between a stochastic and a deterministic origin of the polarization variability. Methods. We have combined multiple data sets of R-band photometry and optical polarimetry measurements of 3C 279, yielding exceptionally well-sampled flux density and polarization curves that cover a period of 2008-2012. Several large EVPA rotations are identified in the data. We introduce a quantitative measure for the EVPA curve smoothness, which is then used to test a set of simple random walk polarization variability models against the data. Results. 3C 279 shows different polarization variation characteristics during an optical low-flux state and a flaring state. The polarization variation during the flaring state, especially the smooth ~360° rotation of the EVPA in mid-2011, is not consistent with the tested stochastic processes. Conclusions. We conclude that, during the two different optical flux states, two different processes govern polarization variation, which is possibly a stochastic process during the low-brightness state and a deterministic process during the flaring activity.

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Keywords

Galaxies: active, Galaxies: jets, Polarization, Quasars: individual: 3C 279